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BY

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SUSCEPTIBILITY OF THE BEAN TO THE VIRUS OF SUGAR-BEET CURLY-TOP[1]

By EUBANKS CARSNER

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The disease of beans (*Phaseolus vulgaris*) of a mosaic type, which is caused by the virus of curly-top in sugar beets, has not been described so far as the writer is aware. The only reference that he knows of in this connection is one by himself,[2] in which the bean was reported as one of the species which had been tested and found nonsusceptible. This statement was made on the basis of a test with the Pink bean, a popular California variety. Interest in the matter was revived when circumstantial evidence suggested the possibility that a disastrous epidemic disease of beans which occurred in Twin Falls County, Idaho, in 1924 might have resulted from infestation of the beans by the leaf hopper *Eutettix tenella* Baker, which transmits the virus of curly-top.

When the question as to the cause of the bean disease in Idaho was raised, seed samples of seven of the varieties of beans commonly grown in Twin Falls County were obtained for the purpose of making test inoculations. Greenhouse plantings were made at once of two of these varieties—the Montana White, or Great Northern, and Prolific Black Wax—and later the plants were inoculated. Viruliferous leaf hoppers were caged on several plants of each variety, and nonviruliferous leaf hoppers were caged on similar plants as controls. The plants on which viruliferous insects were caged became diseased, while the controls remained healthy. Later, to prove that the diseased beans had curly-top, nonviruliferous leaf hoppers were caged on them and then transferred to healthy beets. The beets to which these insects were transferred developed symptoms of curly-top.

The symptoms of the disease on the beans were marked dwarfing and distortion of the leaves which grew out after infection had occurred. These affected leaves became darker green than were the corresponding leaves of the check plants, and became puckered, with their edges curved downward (fig. 1). The puckering was probably due, as is often the case in curly-top beets, to the severer checking of the growth of the fibrovascular bundles than of the intervening mesophyll. The leaf veins showed slight clearing when viewed by transmitted light, as is shown conspiciously by affected beets, but no irregular swellings such as are so characteristic of the disease in beets were found.

The greenhouse inoculations indicated a difference in susceptibility to the disease between the two varieties, the Montana White seeming more resistant. To test this matter further, field plantings

[1] Received for publication Jan. 4, 1926; issued August, 1926.

[2] CARSNER, E. SUSCEPTIBILITY OF VARIOUS PLANTS TO CURLY-TOP O" SUGAR BEET. Phytopathology 9: 413–421, illus. 1919.

were made of the two varieties mentioned, and also of five other varieties. Fifty to 75 plants of each variety were inoculated by caging four viruliferous leaf hoppers on each plant. One month after inoculation the following observations were recorded:

FIG. 1.—Curly-top of garden bean (*Phaseolus vulgaris*, var. Prolific Black Wax). Five viruliferous leaf hoppers were caged on the plant on the right on December 24, 1924. Five nonviruliferous leaf hoppers were caged on the plant on the left on the same day. (Photographed January 13, 1925)

The Montana White, or Great Northern, variety seemed rather resistant; the inoculated plants were only slightly smaller and less healthy in appearance than the uninoculated controls.

Prolific Black Wax was less resistant than Montana White, but was not as susceptible as the other five varieties.

Pencil Pod Black Wax was slightly more susceptible than Black Prolific.

Giant Stringless, Full Measure, and Improved Golden Wax seemed about equally susceptible and slightly more so than Pencil Pod Black Wax.

Black Valentine seemed most susceptible of all.

When the last observation was made on these field plants on September 17, about two-thirds of the plants in the row of Montana White were alive, and one plant was alive in the row of Prolific Black Wax, while in the rows of the five other varieties all plants were dead.

It is of interest to note in connection with these observations on resistance and susceptibility that, according to E. P. Brossard, county agent of Twin Falls County, the Montana White, as well as the Pink variety, was injured in decidedly less degree by the epidemic disease in that district than were other varieties, and that Black Valentine was the most seriously affected of all.

The writer is still uncertain whether the epidemic disease of beans in southern Idaho was curly-top or not. The epidemic was called to the writer's attention in the fall of 1924, and he had no opportunity to see affected plants in the field. However, certain lines of circumstantial evidence suggested that the disease might have been curly-top. One phase of this evidence which seems worth mentioning is the fact that the leaf hoppers invaded the cultivated areas of southern Idaho in enormous numbers in 1924; and the fact, observed by Severin [3] and by C. F. Stahl and the writer (unpublished), that when the leaf hoppers fly into cultivated areas in immense numbers they at first settle down on practically any green vegetation. Aside from this observation and the reported similarity in varietal resistance, it might be mentioned that the symptoms as described to the writer by Brossard and another observer corresponded to the curly-top symptoms seen when viruliferous leaf hoppers were caged on healthy bean plants. In the season of 1925 no serious damage to beans from disease was reported in southern Idaho. The writer has no direct evidence to support the view, but he is inclined to think that the nonoccurrence of the epidemic disease in that district in 1925 may be correlated with the fact that the number of the beet leaf hoppers was very much less in 1925 than in 1924, when there was a great abundance of them.

In regard to the occurrence of curly-top on beans in California, the writer has made no observations in commercial fields in that State. He is, however, authorized to quote the following statement made to him by Henry H. P. Severin, of the California Agricultural Experiment Station, who conducted studies in 1925 when the beet leaf hopper was exceedingly abundant in California:

> It was demonstrated that many varieties of field beans, as well as a large number of other crops, were affected with curly-top under natural conditions. In the lower Salinas Valley where Small White beans were grown in the vicinity of a beet field which had been plowed under owing to curly-top, the beet leaf hoppers flew into the bean fields, and an average of 63 per cent

[3] The following is quoted from a manuscript by H. H. P. Severin now being prepared: "San Joaquin Valley—Flights in middle valley: When the immense swarms of beet leaf hoppers flew into the cultivated regions on Apr. 14, 1919, they were found during the next day generally distributed on green vegetation, but later they congregated on their most favorable host plants for the purpose of feeding and egg laying."

of the bean plants showed typical symptoms of the disease on August 19–20. Bean plants showing curly-top symptoms were transplanted from the field to flower pots in the greenhouse. Noninfective beet leaf hoppers were allowed to feed on these bean plants for a period of three days or longer, and were then transferred to healthy sugar beets. In the cases where the beets developed curly-top, plainly the curly-top virus had been transmitted from bean plants naturally infected under field conditions. Noninfective leaf hoppers which had been allowed to feed on apparently healthy bean plants which had been transplanted from the field failed to produce curly-top in beets. Such leaf hoppers after feeding on healthy beans grown from seed in the greenhouse also failed to transmit the virus.

The question whether or not the leaf hopper finds the bean a favorable host plant is significant from the standpoint of the amount of damage to the crop that may be expected from curly-top. That the bean is not a favorable food plant for the insect is indicated by the fact that in cage experiments all of the leaf hoppers died within 17 days after being caged on the beans. Principally on this account the writer is inclined to the opinion that it is only in seasons when the leaf hopper is relatively very abundant that serious damage to the bean crop from curly-top may be expected, rather than that the disease will be a continual menace as it is to sugar beets.

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